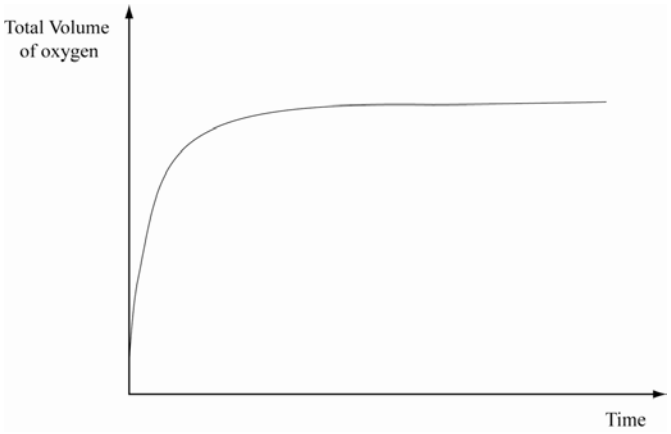
Decomposition

1) Students in a laboratory are asked to identify three powders by using a thermal decomposition reaction.
The powders are copper hydroxide, Cu(OH)2, sodium carbonate, Na2CO3, and sodium hydrogen carbonate, NaHCO3.
Explain how you could identify each of these powders by heating them. Your answer should include:
• any observations that would be made
• any tests that would be carried out on products formed to confirm their presence
• balanced symbol equations for any reactions occurring.

2) A group of students carried out an investigation into whether or not various solid carbonates undergo thermal decomposition. The students found that copper (II) carbonate did decompose when heated. Discuss the thermal decomposition of copper (II) carbonate. In your answer, you should:

- name the products formed
- describe what would be observed during the decomposition
- explain why a solution of limewater would be useful in this investigation
- fully explain what happens to the carbonate ions in the decomposition reaction
- write a balanced chemical equation for the decomposition reaction.

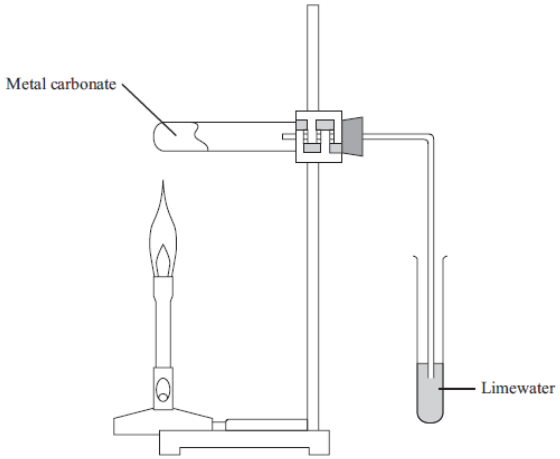
3) A solution of hydrogen peroxide decomposes into water and oxygen gas very slowly. A catalyst can be used to speed up this reaction. The sketch graph below shows the volume of oxygen produced over the course of time when a catalyst is used.



Discuss the decomposition of hydrogen peroxide using a catalyst. In your answer, you should:

- name a catalyst that would be suitable for this reaction
- describe what would be observed during the decomposition reaction
- explain why only a small amount of catalyst is needed to catalyse this decomposition reaction
- fully explain what happens in the catalytic decomposition of hydrogen peroxide over time as shown in the graph above.

4) Three carbonate compounds, sodium carbonate, zinc carbonate and copper carbonate, are heated one at a time in the apparatus shown in the diagram below.



Complete the following table for the above reactions.

Metal carbonate	Colour before heating	Colour after heating	Gas produced (if any)	Ease of decomposition (easy or difficult)
Sodium carbonate	white			
Zinc carbonate	white			
Copper carbonate	green			

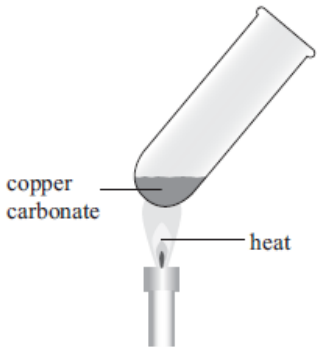
(b) Discuss the differences in the decomposition of sodium carbonate, zinc carbonate, and copper carbonate. In your answer:

- Describe the differences between the reactions of the three carbonates.
- Link the relevant species to the observations you recorded in the table in (a).
- Include any balanced equations.

5) Some green copper(II) carbonate powder is heated in a boiling tube over a Bunsen flame. A burning splint inserted into the top of the boiling tube goes out.

Discuss the chemistry in this thermal decomposition reaction by:

- describing ONE other observation that would be made during this reaction
- linking the observations to the relevant chemical species
- writing a balanced equation.



6) Some dry copper(II) hydroxide was heated in a test tube over a Bunsen burner. When a piece of blue cobalt chloride paper was held in the mouth of the test tube, the paper turned pink. Discuss what happened in the reaction in the **test tube**.
Your answer should include any observations that would occur, and link all the observations to the reactants and products involved. Include an appropriate balanced equation in your answer.

7)

$$\text{calcium carbonate} \xrightarrow{\text{heat}} \underline{\qquad\qquad} + \underline{\qquad\qquad}$$

8) A small amount of zinc hydroxide is heated in a test tube over a Bunsen burner. The following reaction occurs.

$$Zn(OH)_2(s) \xrightarrow{\text{heat}} ZnO(s) + H_2O(g)$$

(a) State what **type** of reaction is occurring.
(b) Fully describe the **observations** that would be expected if this reaction was carried out in a school laboratory. Remember to **link** your observations to the substances involved.

9) A group of students carried out an investigation into the thermal decomposition of the following solid carbonates: sodium carbonate, calcium carbonate, and copper carbonate.
(a) Describe the appearance of each carbonate before it was heated.

	Carbonate	Initial Observation (before heating)
(i)	Sodium carbonate	
(ii)	Calcium carbonate	
(iii)	Copper carbonate	

(b) Describe the observations the students would have made when heating each of the carbonates.

	Carbonate	Observations made during heating
(i)	Sodium carbonate	
(ii)	Calcium carbonate	
(iii)	Copper carbonate	

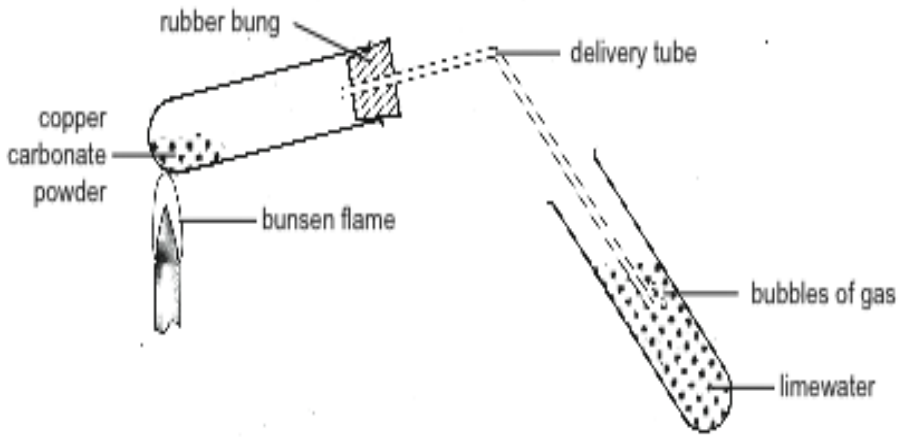
(c) Write a balanced equation for the thermal decomposition of copper carbonate.

10) lead hydroxide $\xrightarrow{\text{heat}}$ _____ + _____

11)

copper hydroxide	→ heat		+	

12) A sample of copper carbonate is heated strongly in a boiling tube fitted with a delivery tube. The gas formed is bubbled into limewater. (*See the diagram below.)*



(i) Describe TWO observations, other than bubbles of gas, that would be made:

(ii) Write a balanced equation for the reaction that occurs when copper carbonate is heated:

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